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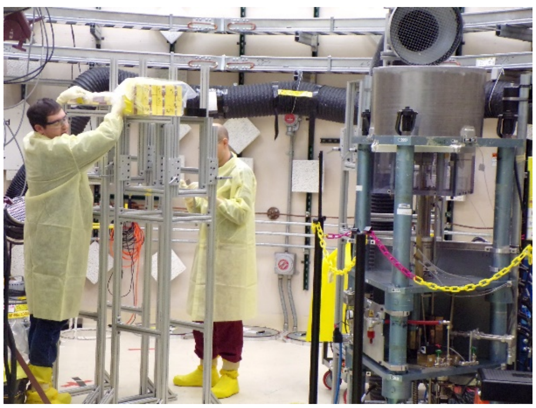
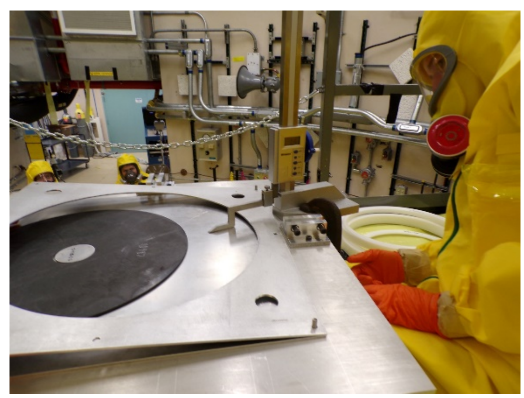
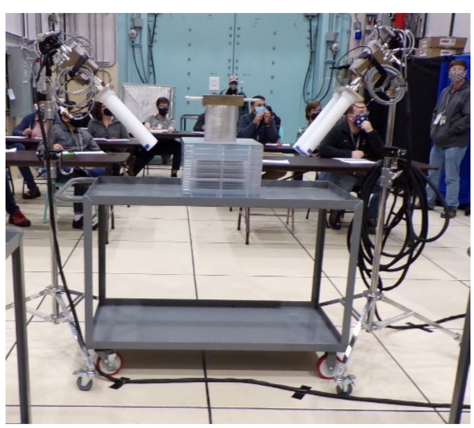
NCERC
NATIONAL CRITICALITY EXPERIMENTS RESEARCH CENTER

2020 ACCOMPLISHMENTS
National Criticality Experiments Research Center (NCERC)







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NCERC Mission Statement:

"The mission of the National Criticality Experiments Research Center (NCERC) is to conduct experiments and training with critical assemblies and fissionable material at or near criticality in order to explore reactivity phenomena, and to operate the assemblies in the regions from subcritical through delayed critical. One critical assembly, Godiva-IV, is designed to operate above prompt critical."

2020 ACCOMPLISHMENTS

SUMMARY

2020 NCERC Operations included:

5 Critical Assembly Experiment Campaigns

- Comet: Critical Unresolved Region Integral Experiment (CURIE)
- Comet: Thermal/Epithermal eXperiments using HEU (TEX-HEU)
- Planet: Measurement of Uranium Subcritical and Critical (MUSiC)
- Godiva: Measurements for Multiphysics Modeling
- Godiva: Short-Lived Fission Product Yield Measurements

6 Criticality Safety Classes

- Two Nuclear Criticality Safety Program (NCSP)-sponsored sessions for managers of fissionable material operations and nuclear criticality safety professionals throughout the DOE complex
- Two sessions for Emergency Response personnel
- Two sessions for PF-4 Fissile Material Handlers

Radiation Test Object Measurement Campaigns

RTO Operations were impacted by the COVID-19 pandemic response. Some RTO builds and measurements took place as part of certain criticality safety classes, but most of these operations were pushed to 2021 and beyond.

Total Number of Operations:						
Dates	**Comet**	**Planet**	**Flat-Top**	**Godiva**	**RTO**	**Total**
2020	54	20	6	19	8	107
2019	20	47	11	8	75	161
2018	41	50	21	14	81	221
2017	56	20	22	14	75	187
2016	37	15	14	18	66	150

NCERC-FO Activities to Maintain Capability

Engineering

- Reviewed 2 Design Calculations, initiated 4 Design Change Forms (DCFs), completed 14 Post-Maintenance/Modification Tests (PMTs), 10 System Health Reports (SHRs), revised 12 System Management Level Determinations (MLDSs) and created 12 Component Management Level Determinations (MLDCs), made 12 updates to the Master Document List/Technical Baseline List (MDL/TBL), and 13 drawing updates.
- Incorporated DOE O 441.1 requirements for SAVYs into Configuration Management
- Wrote Requirements and Criteria Document (RCD) and successfully obtained funding for the NCERC Controls Upgrade
- Installed Planet Leveling Upgrade
- Reviewed Master Equipment List (MEL) for consistency between all safety significant components and drawings and began walk-downs to verify drawings.

Maintenance

- Performed 34 procedures successfully (Maintenance, In-Service Inspections, and Surveillances).
- Developed a mechanical material handling procedure, inventoried and inspected all mechanical material handling equipment, developed a tracking system for load capacities and inspection dates
- Completed Triennial Nuclear Maintenance Management Program (NMMP) Assessments for both NFO and LANL.
- Coordinated annual face velocity/DOP testing of 4 HEPA systems

Quality Assurance

- Closed 9 action items in Issues Management
- Completed 5 receipt inspections/verifications

Tours

- Supported tours for LANL Managers, the LANL Deputy Director for Science, Technology, & Engineering (DDSTE) Office, and the NNSA Office of Production Modernization (NA-19).

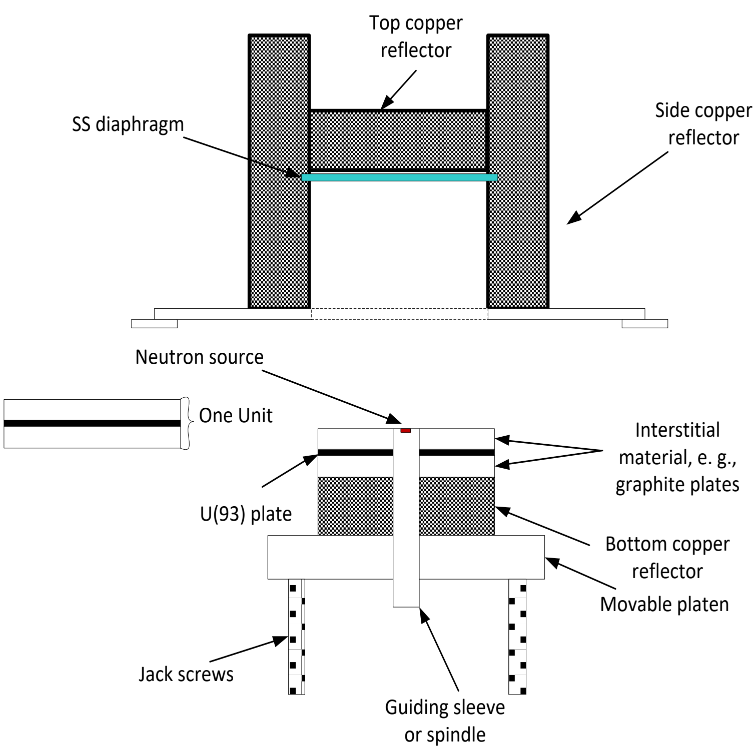
Other Notable Activities:

- 78 DAF Access Requests processed
- 55 material moves completed
- Wrote and utilized a procedure for opening and unpacking 9977 and 9975 shipping containers
- Performed the Zero Power Physics Reactor (ZPPR) plate receipt, repack, and stage
- Supported annual inventory for MC&A and facility inspections (ISIs) for DAF Engineering
- 111 controlled documents reviewed, revised, or rewritten
- Unpacked, measured, inventoried and photographed, repackaged, and cleaned 1,893 beryllium metal components
- 61 equipment approvals coordinated
- Developed the NCERC Environmental Action Plan
- Full inventory of non-accountable sources completed with MSTS Radiological Control Team.

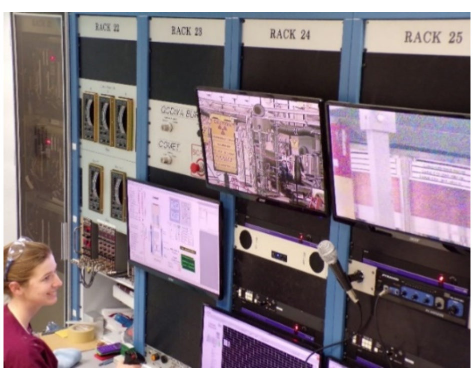
Critical Assembly Experiments

CURIE on Comet

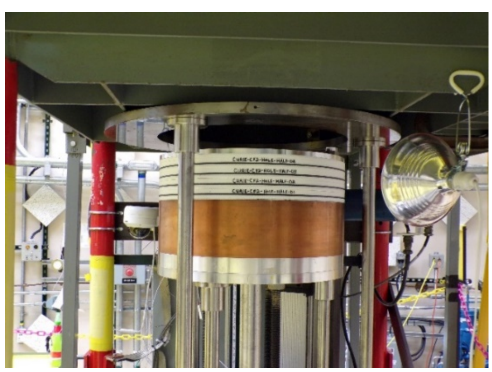
The Critical Unresolved Region Integral Experiment (CURIE) measurement campaign was designed to evaluate HEU in the narrower unresolved resonance region (URR) of U-235, and builds on the knowledge gained from Zeus experiments.



CURIE builds on the Zeus Intermediate Energy Range experiments with U-235, but focuses on the narrower Unresolved Resonance Region (URR). Teflon moderator plates and U-235 Jemima Plates were stacked in five benchmark configurations and surrounded by copper reflector to obtain data used for cross section and transport code validation of the U-235 URR. Rossi-alpha measurements were also performed over the range of configurations to provide information on the kinetics parameters, such as beta effective of the systems.



▲*NEN-2's Theresa Cutler operates the assembly remotely.*



▲*One experimental configuration.*

▲*Experimenters prepare the Teflon moderator and U-235 Jemima plates.*

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Critical Assembly Experiments

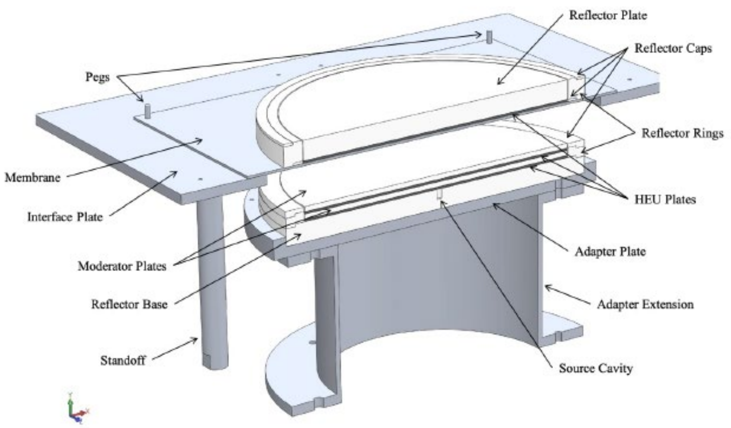
TEX-HEU on Comet

The Thermal/Epithermal eXperiments using HEU moderated and reflected by polyethylene was a collaboration with LLNL to perform an integral critical benchmark to validate data in the intermediate energy range.

TEX-HEU utilized HEU Jemima plates interleaved with polyethylene plates. By varying the thickness of the polyethylene plates, the neutron spectrum of the experiment could be fine-tuned to a specific fission energy regime. The TEX Program goal is to design critical experiments that can be easily modified to include various high priority materials identified by the international criticality safety and nuclear data communities.

▲*Experimenters align the load on the lower platen.*

▲*The upper and lower experiment configurations are shown.*



Critical Assembly Experiments

MUSiC on Planet

The Measurement of Uranium Subcritical and Critical (MUSiC) experiment utilized bare HEU hemishells and aluminum mock shells with a variety of neutron sources to perform subcritical and critical measurements.

◀*The experiment configuration loaded on Planet, shown with the platen in both the lowered and raised state.*

The large range of multiplication of this campaign (from delayed supercritical to deeply subcritical) tests the methodologies for data analysis and simulation for the full range of neutron multiplication. All configurations consist of subsets of the Rocky Flats shells with varying amounts of interior aluminum mock shells and a source holder. Results will provide a better understanding of the limitations and applicability of different methodologies at different multiplications.

▲*NEN-2's Michael Hua, Geordie McKenzie, and Nick Thompson operate the assembly remotely.*

▲*NEN-2's Kenny Valdez and Justin Martin install experimental equipment.*

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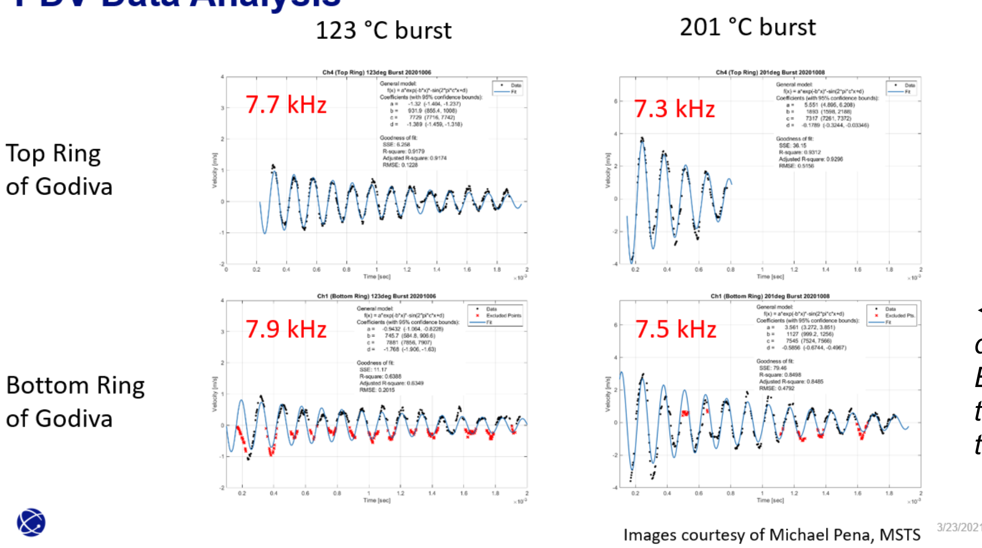
Critical Assembly Experiments

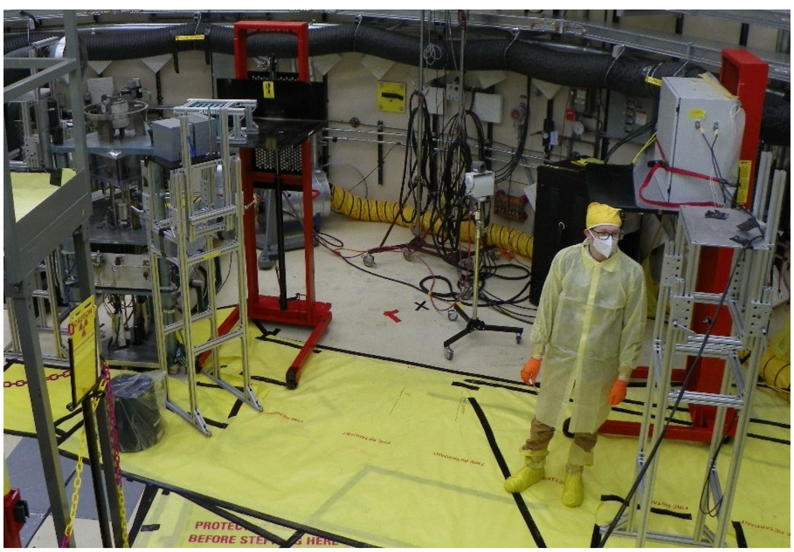
Measurements for Multiphysics Modeling on Godiva

Precise flux measurements at various delayed-critical power levels were made to collect information from the operation of the Godiva IV fast burst reactor to support multi-physics modeling efforts. Surface displacement measurements during burst operations were obtained using the portable Photonic Doppler Velocimeter (PDV) detector. These measurements were a collaboration between LANL, LLNL, and MSTS.

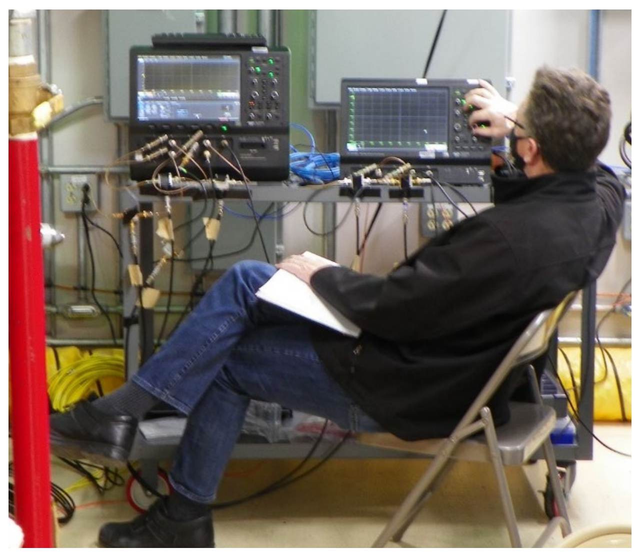
PDV Data Analysis



◄*Burst data from the MHD-240 detector is fit to the PDV signal. Each channel is scaled and shows the coverage of the burst signal over ten orders of magnitude.*



▲*NEN-2's Alex McSpaden shown with the experiment setup.*



▲*MSTS's Robert Buckles adjusts his equipment.*

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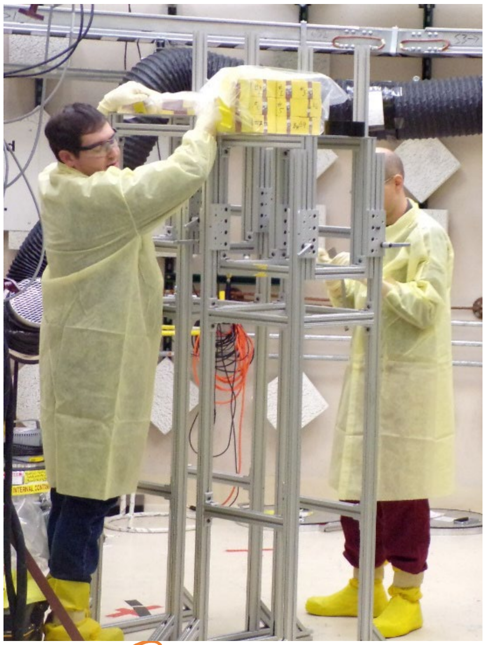
Critical Assembly Experiments

Short-Lived Fission Product Yield Measurements

A fast burst reactor such as Godiva IV is ideal to perform experiments that reduce the uncertainty in the measurement of the yield of short-lived fission products because a large number of fission products can be generated simultaneously and nearly instantaneously.

To perform these measurements, small, pure, single-isotope actinide samples are encapsulated in quartz ampules. The ampules are loaded into a sample holder and placed in the glory hole. A burst is performed and the samples retrieved as quickly as possible, generally within 20 minutes, and transferred to a calibrated high-purity germanium (HPGe) detector. The gamma rays from the decaying fission products are counted to determine the number and type of fission products that were created during the burst. By counting so quickly after the fissions occurred, it is possible to determine the yield of the shortest-lived fission products.

◄*Experimenters in respirators set up the experiment.*



The first sample measured was U-235 in 2014. Due to the very long analysis process for the data, subsequent measurements occurred roughly every two years. In 2016, the same process was followed for U-238, again in 2018 for Pu-239, and most recently in 2020 for Np-237. Future plans include U-233 measurements in 2021. These experiments mark the first time that all samples have been irradiated in the same environment and counted with the same detector setup.

◄*NEN-2's Jessie Walker and Jesson Hutchinson install samples for irradiation (January 2020).*

Criticality Safety Classes

Criticality Safety Training supports activities across the DOE complex by providing hands-on experience to demonstrate the effects of criticality safety parameters on fissile material operations.

▲*NEN-2's Theresa Cutler and NEN-DO's Mary Hockaday participate in a hand-stack as part of the class foils experiment.*

Training Objectives:

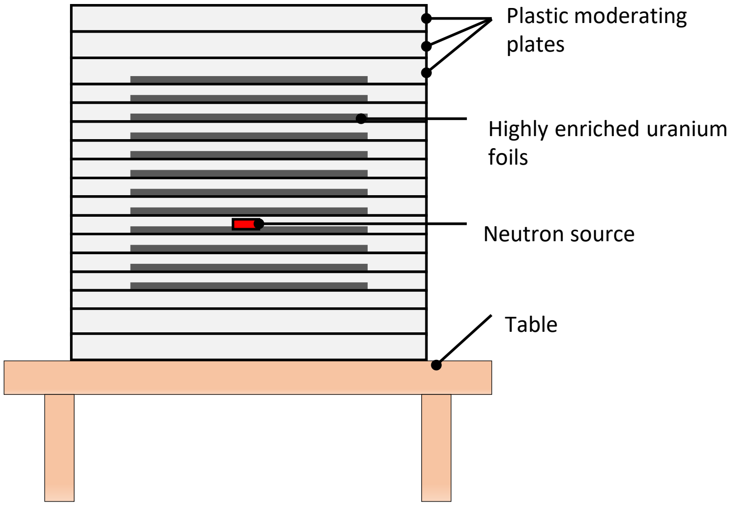
- Criticality safety fundamentals
- Critical experiment methodology
- Review of process and criticality accidents
- Hands-on nuclear material and critical assembly operations

Participants Include:

- Criticality safety engineers
- Criticality safety officers
- Fissile material operations managers
- TA-55 operators and process supervisors
- Nuclear engineering students and emergency responders

Class Foils Experiment

- Participants build a critical experiment using plastic moderating plates and highly enriched uranium (HEU) foils interleaved together.
- Participants use the 1/M approach-to-criticality method to calculate a relative neutron multiplication and guide the construction of a critical configuration.
- Demonstrates the effects of parameters important to nuclear criticality safety (MAGIC-MERV)



2020 ACCOMPLISHMENTS

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Criticality Safety Classes

DOE Nuclear Criticality Safety Program (NCSP) Classes

Criticality Safety classes for the National Criticality Safety Program are conducted regularly. Personnel from all DOE facilities that work with fissionable come to NCERC to conduct hands-on experiments designed to demonstrate the effects of changing parameters important to nuclear criticality safety.

▲ *Each participant handles the alpha-phase plutonium BeRP ball.*

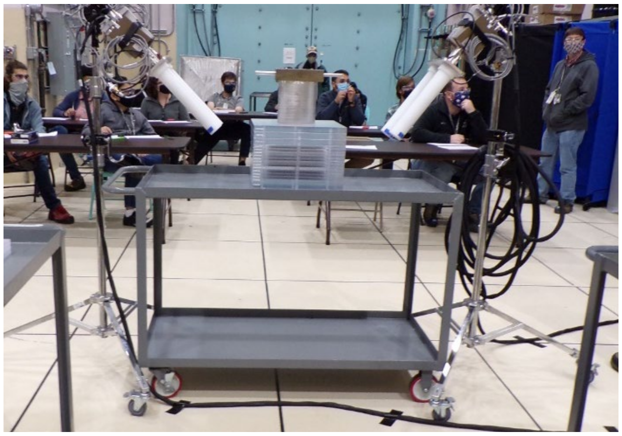
PF-4 Class

LANL personnel involved in plutonium operations attend criticality safety classes to gain hands-on experience performing critical experiments, increase their knowledge of criticality safety, and learn about past criticality accidents and how to avoid them.

▲ *Class attendees visit a snowy Sedan crater.*

Criticality Safety Classes for Emergency Response Personnel

These criticality safety classes are conducted regularly and focus on criticality safety for emergency response personnel.



▲ *NEN-2's Travis Grove participates in a hand-stack as part of the class foils experiment.*

Fissile Material Handling

Material Moves

Fissionable material moves are conducted between NCERC buildings to support activities that require the use of fissile material. These activities can be complex and require the support and coordination of facility, security, and programmatic personnel. Criticality safety and conduct of operations are important components of a successful material move.

▲NCERC-FO Fissile Material Handlers Ryan LeCounte, Daniel Perlstein, Lauren Spirodek and Eloura Phelps inspect packaging and verify contents prior to conducting the move.

YEAR	# FM MOVEMENTS
2020	55*
2019	216
2018	197
2017	163
2016	97

**the COVID-19 pandemic limited the number of operations at NCERC in 2020.*

SAVY Repackaging

In 2020, NCERC began the process of repackaging staged material into DOE Order 441.1 compliant SAVY containers. Fissile Material Handlers (FMH) obtained an additional qualification to utilize these containers. A seismic analysis was completed to allow SAVY containers in centering fixtures.

▲FMH demonstrating how to open a SAVY.

▲SAVY staged in NMC-5 centering fixture.

Fissile Material Handling

ZPPR Plate Repackaging and Staging

Zero Power Physics Reactor (ZPPR) plate repackaging has been an ongoing operation since 2017.The material is received in 9977 drums, unpacked, weighed, inspected, and repackaged into SAVY containers. The ZPPR plates have been utilized for past critical experiments and will be used in future experiments being developed. In 2020, NCERC wrote and utilized a procedure for opening and unpacking 9977 and 9975 shipping containers.

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ATTACHMENT A: UNPACKING CHECKLIST FOR THE MODEL 9975-96
(Page 1 of 8)

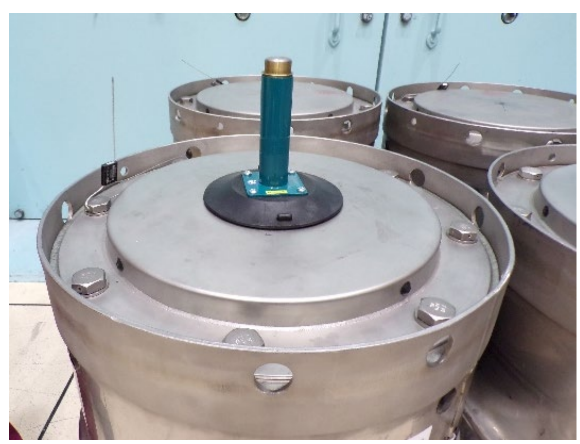
Section I: Unpacking Pre-Performance Checks		
Step	**Action**	**Initials/Comments**
	NOTE This checklist must be used in conjunction with another NCERC procedure that provides controls for fissionable material handling.	
1	ENSURE this unpacking checklist is the latest revision.	
2	ENSURE to have on file or have access to current Certificate of Compliance and S-SARP-G-00003 for reference.	

Section II: Special Tools, Equipment, Parts, and Supplies		
Step	**Action**	**Initials/Comments**
3	Measuring and Test Equipment (M&TE): • Torque Wrench: 30 ± 2 ft-lb Calibration Due Date: ____________ Sticker Number: ____________	
4	Lifting and Handling Equipment: • Crane, if used: Expiration Date: ____________ • Rigging Equipment, if used: Expiration Date: ____________	
5	ENSURE that any handling/lifting equipment is rated for required weight range.	
6	Customized Tools: • Secondary Containment Vessel (SCV) and Primary Containment Vessel (PCV) lifting devices • Holding fixtures • Torque block	

IN-HAND USE

▲ *Fissile Material Handlers remove a tray of ZPPR plates from a SAVY container.*

▲ *Fissile Material Handlers team up to open 9977 containers.*



▲ *Unique equipment is required to unpack 9977 containers.*

NCERC Facility Operations

Inter-Organizational Collaboration

MC&A Annual Inventory

NCERC maintains a substantial special nuclear material (SNM) inventory. Every year in collaboration with MSTS Material Control & Accountability, each component is confirmed. This includes materials in the DAF as well as the NCERC warehouse.

▲*Jemima Plates staged to be inventoried and weighed.*

DAF Engineering Support

NCERC engineers coordinate with MSTS DAF Facility Engineers to complete DAF In-Service Inspections, particularly the annual inspection of the vault locations that stage NCERC's nuclear material.

Full Inventory of Non-Accountable Sources with MSTS RadCon Support

The NCERC Source Custodian updated and corrected source labels, created an inventory spreadsheet and tracking system, determined which sources required hot operations for handling, and assisted RadCon with leak testing.

Tours

NCERC is a one-of-a-kind program and the DAF is a unique facility. We have had the opportunity to host many guests interested in the missions and capabilities of NCERC. In 2020, this included visitors from LANL Management, the Deputy Director for Science, Technology, & Engineering (DDSTE) Office, and the NNSA Office of Production Modernization (NA-19).

NCERC Facility Operations

Quality Assurance

NCERC QA approves and analyzes management level equipment procurements, evaluates the validity and acceptability of inspection results and M&TE calibrations, and monitors operations for adherence to project plans, specifications, and procedures. In 2020, nine items in the Issues Management System were closed. Five Receipt Inspections and verifications were completed.

▲*ML-2 components for the MUSIC experiment were received in Nevada. A receipt verification inspection was performed by NCERC-FO QA and Engineering personnel.*

Maintenance

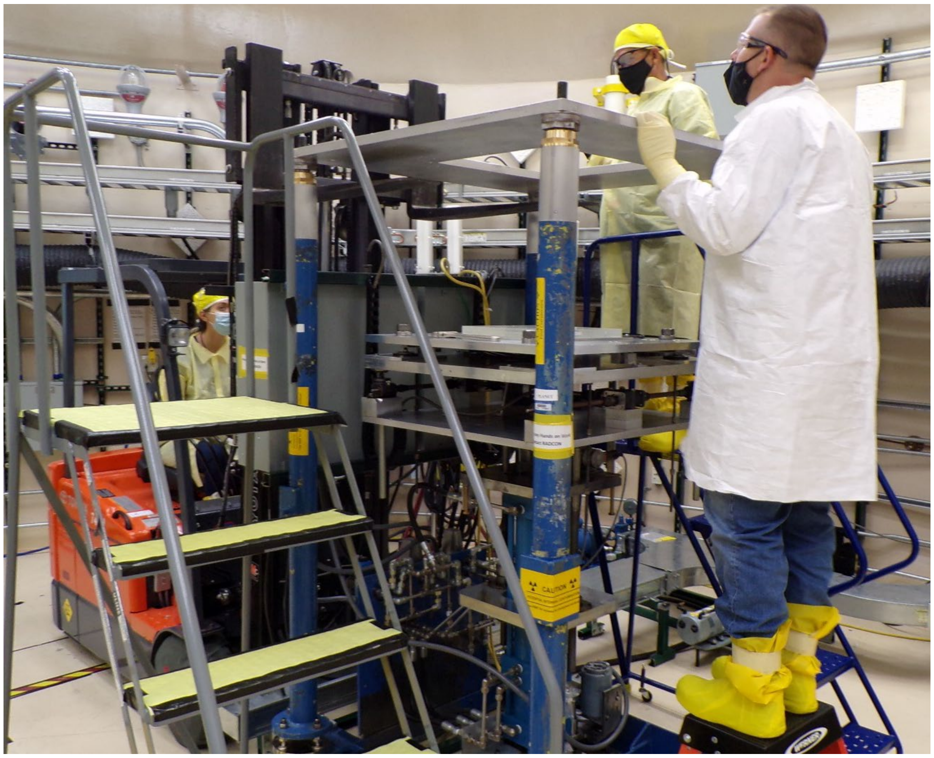
Each critical assembly has TSR-required surveillances, inspections, and maintenance procedures that must be performed at specific intervals. In 2020, NCERC Maintenance personnel performed 34 of these procedures, developed a mechanical material handling procedure, inventoried and inspected all mechanical material handling equipment, developed a tracking system for load capacities and inspection dates, coordinated annual face velocity/DOP testing of 4 HEPA systems, and completed the Triennial Nuclear Maintenance Management Program (NMMP) Assessments for both NFO and LANL.

▲*NCERC-FO's Arnold Harper and a CSE complete the annual maintenance procedure on the Godiva assembly.*

NCERC Facility Operations

Engineering

NCERC Cognizant System Engineers are responsible for maintaining configuration management and completing the required Conduct of Engineering procedures associated with each critical assembly and the associated safety systems. In 2020, NCERC CSEs reviewed 2 Design Calculations, initiated 4 Design Change Forms (DCFs), completed 14 Post-Maintenance/Modification Tests (PMTs), 10 System Health Reports (SHRs), revised 12 System Management Level Determinations (MLDSs) and created 12 Component Management Level Determinations (MLDCs), made 12 updates to the Master Document List/Technical Baseline List (MDL/TBL), incorporated DOE O 441.1 requirements for SAVYs into the Configuration Management plan, and reviewed/walked down the MEL for consistency between all safety significant components and drawings.



◄ Ryan LeCounte (NCERC-FO), Kenny Valdez (NEN-2), and Eloura Phelps (NCERC-FO) change the top plate and remove post extensions on Planet.

Miscellaneous Notable Accomplishments

- 78 DAF Access Requests were processed
- 111 controlled documents were reviewed, revised, or rewritten
- 61 equipment approvals were coordinated
- Developed the NCERC Environmental Action Plan

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NCERC Facility Operations

Planet Leveling Upgrade

NCERC personnel installed leveling components on the base and top of the Planet assembly support columns. This allows for customized alignment for each critical experiment and ease of top plate installation.

▲ *NCERC-FO's Ryan LeCounte, Daniel Perlstein, and Arnold Harper re-install a support column after installing the column leveling bases.*

▲ *The finished product – see the adjustable leveling bases on the bottom and the top plate leveling assembly above.*

NCERC Facility Operations

Requirements and Criteria Document (RCD) for the NCERC Control System Upgrade

NCERC engineers worked with a multi-disciplinary team to write the scope, criteria, and detailed descriptions of equipment to obtain Capability Based Investment (CBI) funding to upgrade the control systems. The current control room and systems are over a decade old. This project will allow new components to be procured, installed, and tested in order to maintain and expand NCERC's critical assembly operational capabilities.

▲ *"Before" – The current Control Room system layout prior to the proposed upgrade.*

Proposed upgrades Include:

- New safety system hardware and programming
- Updated critical assembly machine control systems
- Remote, high-quality, and longer life visual and audio communication systems
- New data acquisition hardware, custom software, and network infrastructure for capturing experiment data
- Integrate the Godiva High Efficiency Particulate Air (HEPA) Air Filtration System (AFS) into the facility infrastructure

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NCERC Facility Operations

Mechanical Material Handling (MMH)

Per new LANL policy, NCERC-FO implemented and trained workers in the practice of MMH, enabling workers to properly evaluate and control work hazards, ensuring protection of personnel, property and the environment.

NCERC Form CEF-F-111	NCERC MMH Activity Screening Checklist	01/20/2021 Rev. 0 Page 1 of 2

1.0 MECHANICAL MATERIAL HANDLING INFORMATION			
1.1 Facility Name:			
	MMH Activity Description		MMH Equipment
Handling	☐ Fissile Material	☐ Bulk Material	☐ Dolly
	☐ Inspection Object	☐ Other:	☐ Cart
	☐ Detector Equipment		☐ Hand Truck
	☐ Gas Cylinders		☐ Pallet Jack
	☐ Dewars		☐ Hydraulic Lift Table
	☐ Liquid Cylinders		☐ Hydraulic Jack
	☐ Office Supplies		☐ Other:
	☐ Shielding Material		

2.0 MECHANICAL MATERIAL HANDLING ACTIVITY ANALYSIS	(Check One)	
2.1 Does this MMH activity meet ALL of the criteria below? If "Yes" is checked for ALL criteria below then proceed to Section 3.0 and designate the MMH load as an *Ordinary Load*. If ANY "No" boxes are checked proceed to Field 2.2.	Yes	No
Note: If the activity is considered to be *Ordinary*, then work is performed per applicable NCERC Activity Level Work Documents (ALWDs).		
• Can the material be easily balanced or secured?	☐	☐
• Is the path of travel clear, is the surface level and is there adequate space or buffer area?	☐	☐
• Is the operator familiar and proficient with the equipment to be used to move the material?	☐	☐
• Is the load capacity of the equipment being used easily identifiable and is the item being moved within the stated capacity?	☐	☐
• Is the equipment being used as intended?	☐	☐

►*Mechanical Material Handling equipment includes carts, drum carts, pallet jacks, and more.*

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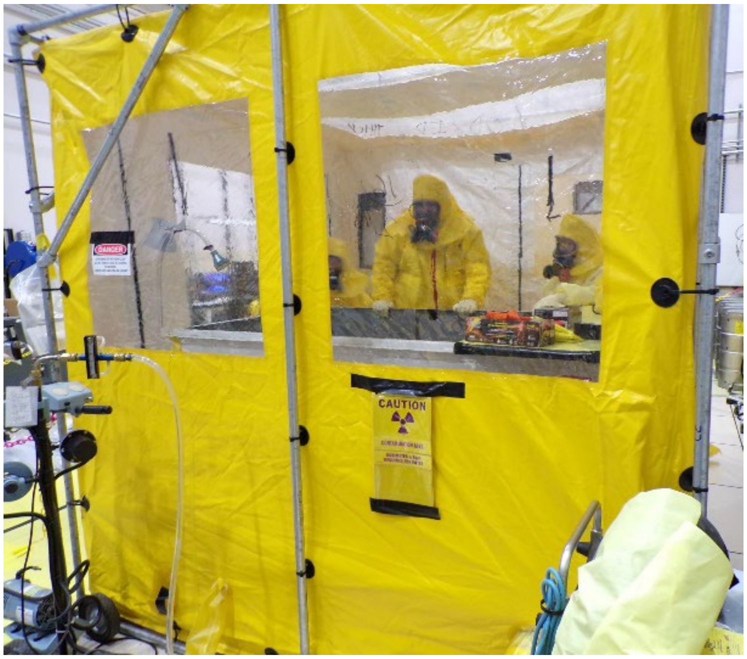
NCERC Facility Operations

Beryllium Inventory

NCERC maintains a large amount of beryllium metal. Beryllium, due to its unique combination of structural, chemical, and neutron cross section characteristics, is used as a neutron reflector for critical experiments. While experimenters were unable to travel to Nevada due to COVID restrictions, NCERC-FO personnel unpacked, measured, inventoried, photographed, repackaged, and cleaned 1,893 beryllium metal components. Some of these components will be used in upcoming 2021 critical experiments, and the beryllium inventory will be tracked and maintained for future experiments.

Quantity	Description
305	Stacked concentric Be rings
1588	Blocks and plates



▲*NCERC-FO and RCTs work together in this HEPA tent to remove, inventory, and repackage each piece of beryllium.*

▲*One beryllium brick shown above a container of mixed beryllium.*

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DAF OVERVIEW

Introduction

Construction began on the Device Assembly Facility (DAF) in the mid-1980s to support underground nuclear testing. DAF was designed and built to consolidate all nuclear explosive assembly functions, to provide safe structures for high explosive and nuclear explosive assembly operations, and to provide a state-of-the-art safeguards and security environment. Now that the United States is under a continuing nuclear testing moratorium, the DAF now provides support for Stockpile Stewardship subcritical experiments, JASPER gas gun experiments, nuclear criticality experiments, and some nuclear materials management activities. Stakeholder involvement includes Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL) as well as other DOD, Homeland Security, and other entities.

Stockpile Stewardship

Device Assembly Facility (DAF)

History

For 41 years, nuclear weapons testing was the primary mission during which nuclear testing operations occurred in a safe, remote, and secure environment. These operations included assembly, disassembly, modification, staging, transportation, maintenance, repair, retrofit, and testing of nuclear devices. The mission of the DAF continues evolving since the nuclear weapons testing moratorium began in October 1992. Current missions are an integral part of the U.S. Department of Energy National Nuclear Security Administration's Stockpile Stewardship Program, which includes work to support subcritical experiments, special nuclear material staging and emergency response training.

Facility Design

The DAF is a collection of more than 30 individual steel-reinforced concrete buildings connected by a rectangular common corridor. The entire complex, covered by compacted earth, spans an area of 100,000 square feet.

Safety systems include fire detection and suppression, electrical grounding, independent heating, ventilation and air-conditioning systems with high-efficiency particulate air filters, alarm systems, and warning lights. In operational areas, pairs of blast doors, designed to mitigate the effects of an explosion, are interlocked so that only one door may open at a time.

The operational buildings in the DAF include assembly cells; high bays; assembly bays; one of which houses a glove box, and one of which houses a down draft table; and radiography bays. Staging bunkers provide space for staging nuclear components and high explosives. All materials packages arrive or depart the DAF through one of two shipping and receiving bays. The support buildings include vaults for staging explosives, or special nuclear material; decontamination areas; and an administration area with office space, a conference area, personnel changing and shower rooms, and a machine shop. In addition, two buildings provide

In addition to its physical isolation, two gun turrets at either end of the facility provide extended security at the DAF.

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DAF OVERVIEW

The DAF includes assembly bays for activities involving uncased conventional high explosives and special nuclear material.

laboratory space, one for conducting instrumentation and environmental testing and the other for observing operations in an adjacent assembly cell.

Assembly Cells (Gravel Gerties)

The assembly cells were named Gravel Gerties after a 1950s comic-strip character. Modeled after the structure at Pantex Plant, these are where hands-on assembly and disassembly of U.S. nuclear weapons and devices would take place. They provide the maximum environmental and personnel protection in the event of an inadvertent high-explosive detonation. Should a detonation occur, the Gravel Gertie would minimize release of nuclear material and its spread to other areas of the facility and to outside areas.

A National Resource

The DAF is a national asset. The design of the facility and its safety features makes the DAF well-suited to address new national challenges - such as the National Criticality Experiments Research Center (NCERC) to the NNSS - which supports maintaining the nation's nuclear stockpile. Additionally, the DAF is used to prepare subcritical experiments and target chambers for the Joint Actinide Shock Physics Experimental Research facility experiments.

Currently the United States is not conducting nuclear tests. However, in 1992 the then President in a Decision Directive pledged to maintain an underground test readiness program in the event that nuclear testing resumes.

Location

The DAF is located in the interior of the NNSS and its remoteness provides a substantial safety zone for the general public, and adds to the security of the facility. In addition, activities at the DAF comply with the National Environmental Policy Act, and all applicable federal, state, and local regulations.

NNSA
National Nuclear Security Administration

For more information, contact:
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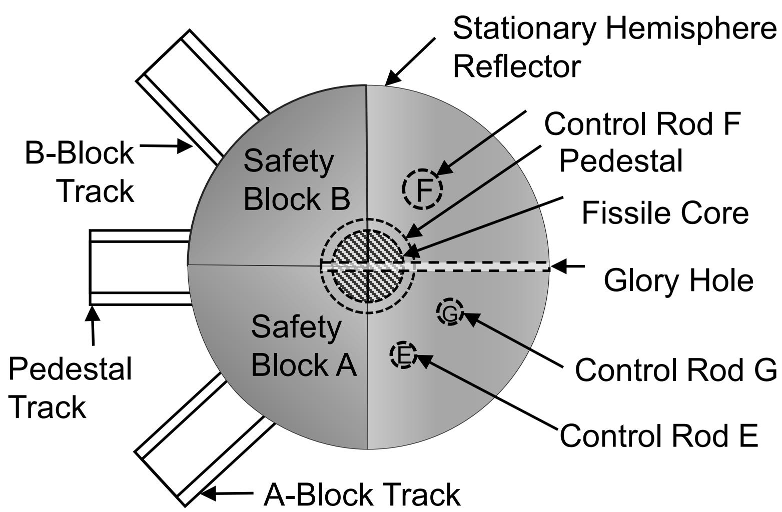
FLAT-TOP OVERVIEW

Flat-Top is a fast spectrum benchmark critical assembly designed to demonstrate fundamentals of reactor physics and used as a general-purpose radiation source.

Flat-Top consists of:

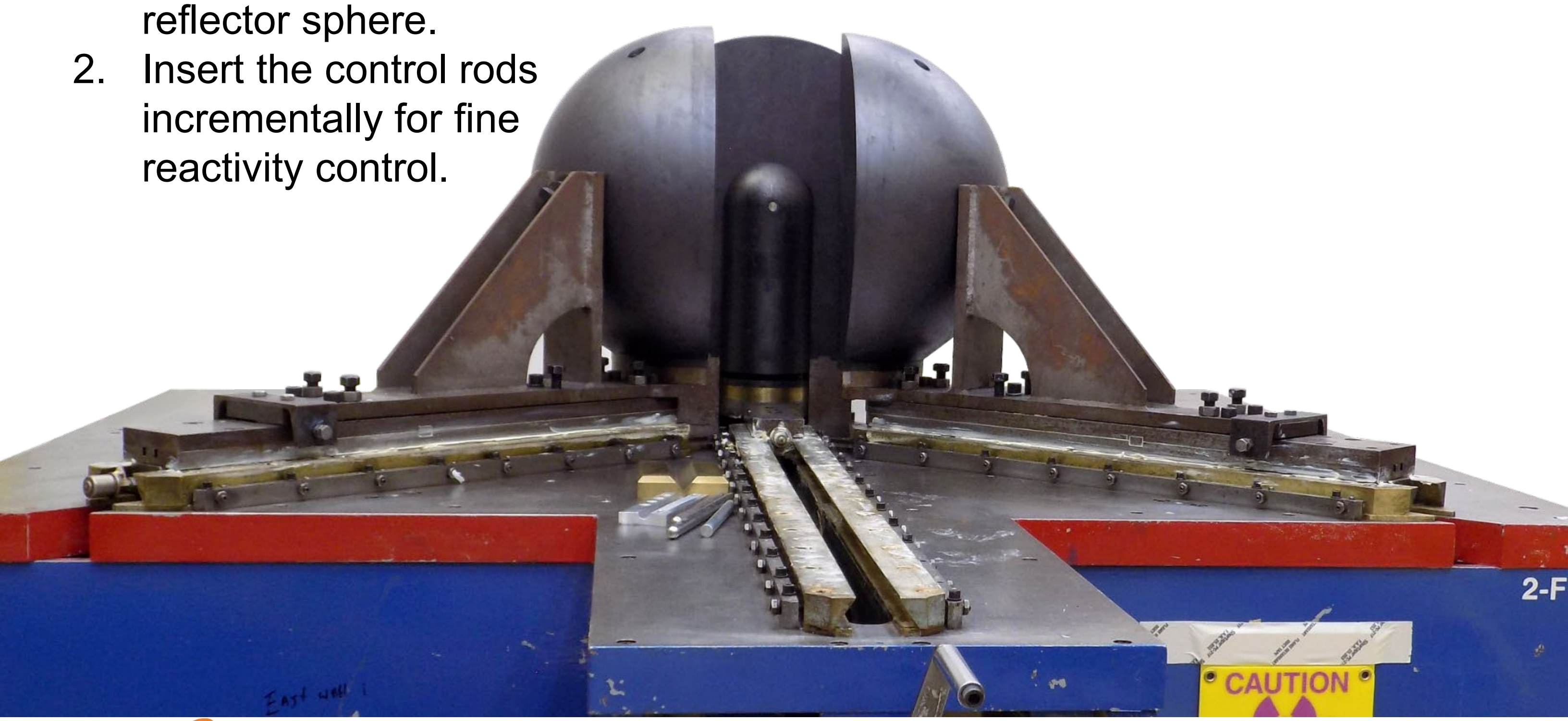
- A spherical, 1,000-kilogram natural uranium reflector,
- Three natural uranium control rods,
- A fissile core - either plutonium or highly enriched uranium (HEU) - seated in a natural uranium pedestal.



Flat-Top Schematic, Top View, Assembled

How it works:

1. Close the safety blocks to complete the reflector sphere.
2. Insert the control rods incrementally for fine reactivity control.



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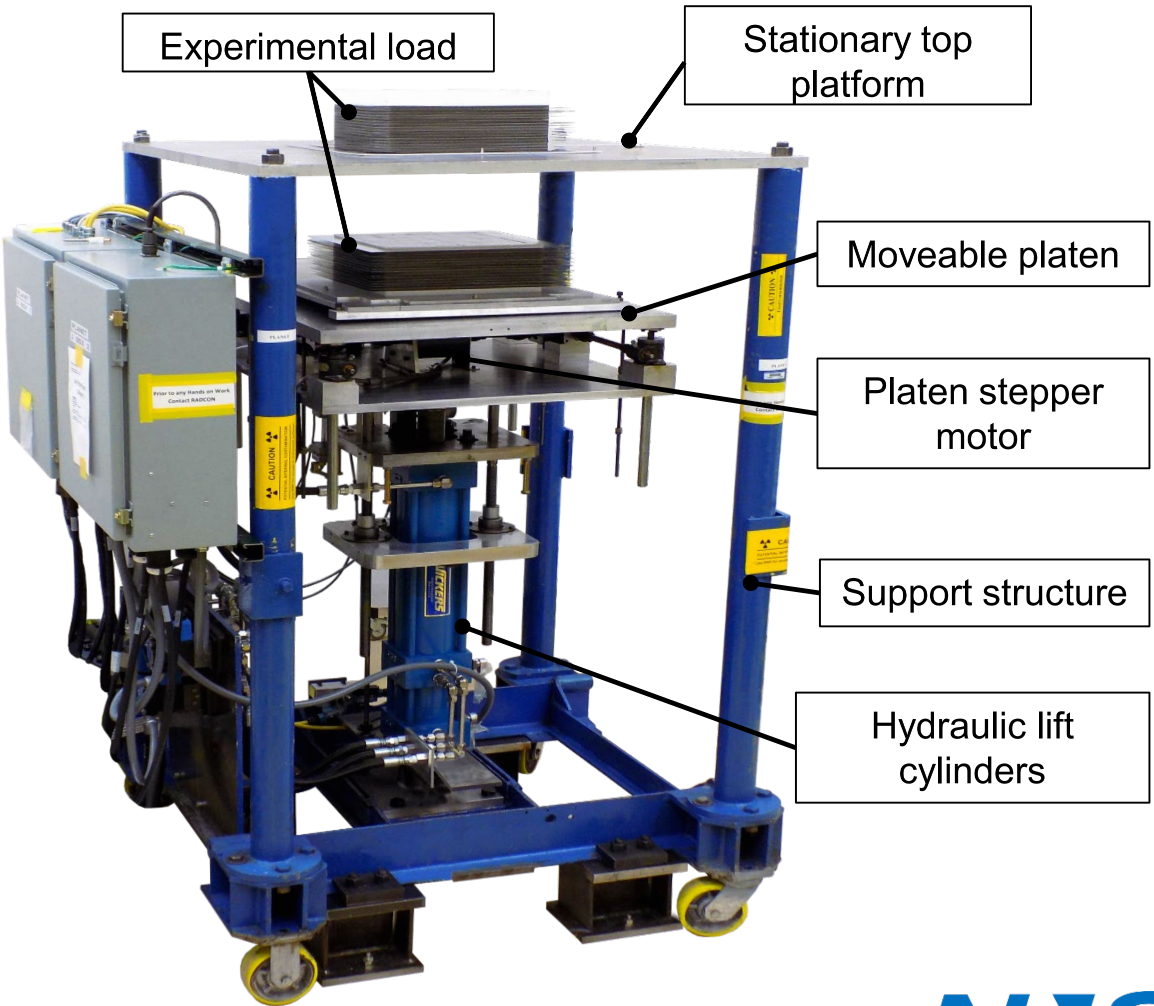
PLANET OVERVIEW

Planet is a general purpose, light duty vertical lift assembly designed for flexibility in conducting a variety of critical experiments.

How it works:

1. Experiment-specific materials for a critical configuration are split into subcritical components.
2. One component rests on the stationary top platform. The other is installed on the moveable platen.
3. The platen is raised remotely to bring the configuration together.

Planet consists of the components shown below:



NCERC
NATIONAL CRITICALITY EXPERIMENTS RESEARCH CENTER

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NNSA
National Nuclear Security Administration

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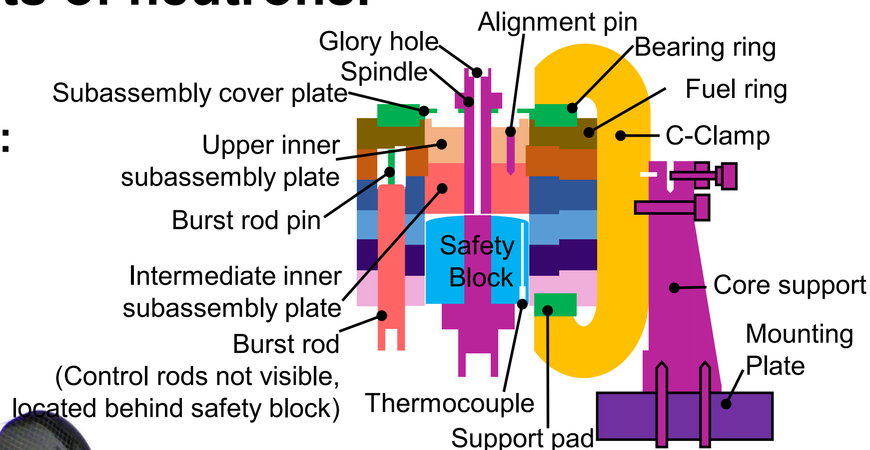
GODIVA OVERVIEW

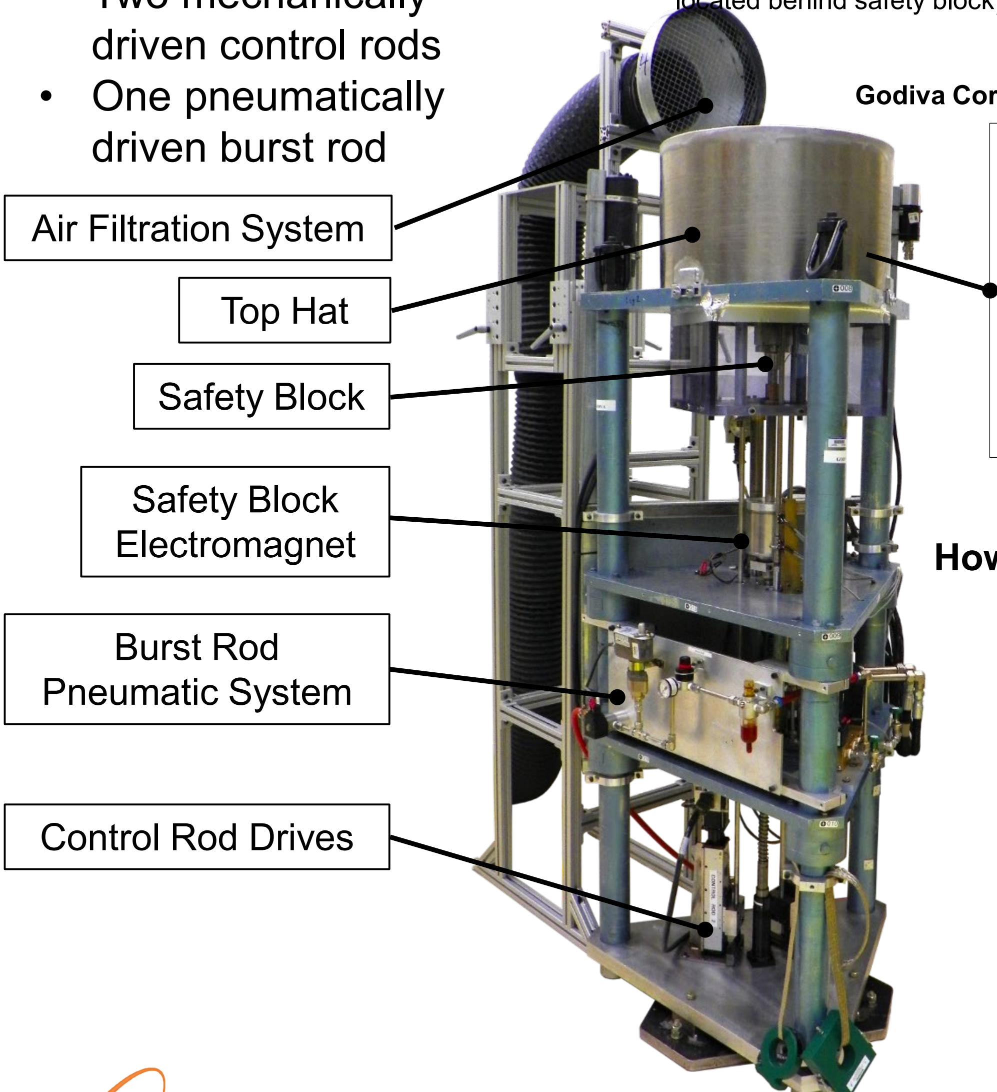
Godiva is a fast burst reactor designed to provide very high powered, short bursts of neutrons.

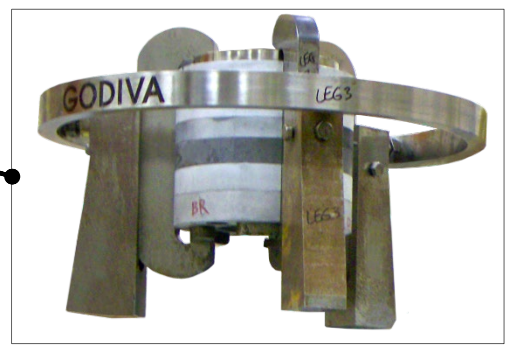
The Godiva highly enriched uranium (HEU) core consists of:

- Six stationary stacked rings
- One moveable safety block
- Two mechanically driven control rods
- One pneumatically driven burst rod



Godiva Core Schematic, Sectional View





Godiva HEU Core underneath the Top Hat

How it works:

1. Insert the safety block.
2. Insert the control rods to set the desired reactivity of the burst.
3. Insert the burst rod. Two operators are required.
4. The shockwave and temperature expansion cause the safety block to retract, resulting in a subcritical system.

NCERC NATIONAL CRITICALITY EXPERIMENTS RESEARCH CENTER

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NNSA National Nuclear Security Administration

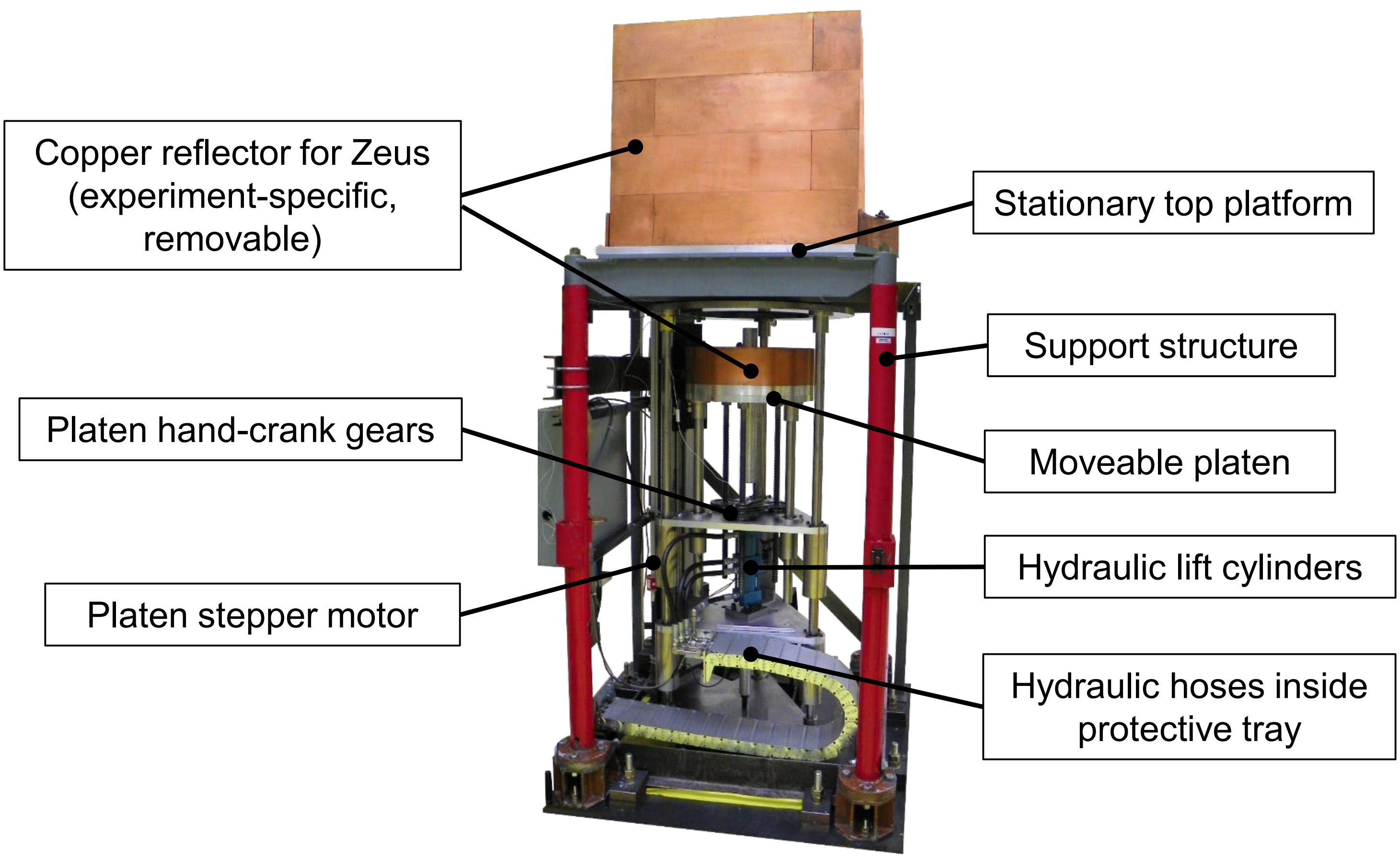
COMET OVERVIEW

Comet is a general purpose, heavy duty vertical lift assembly designed for flexibility in conducting a variety of critical experiments.

How it works:

1. Experiment-specific materials for a critical configuration are split into subcritical components.
2. One component rests on the stationary top platform. The other is installed on the moveable platen.
3. The platen is raised remotely to bring the configuration together.

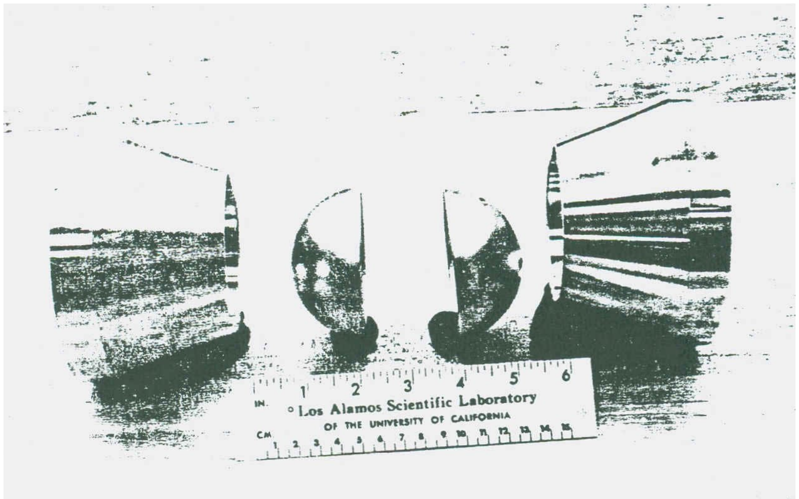
Comet consists of the components shown below:



NCERC Inventory Highlights

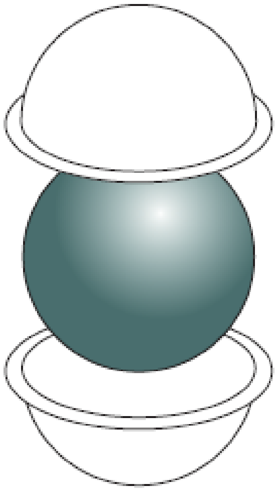
BeRP Ball

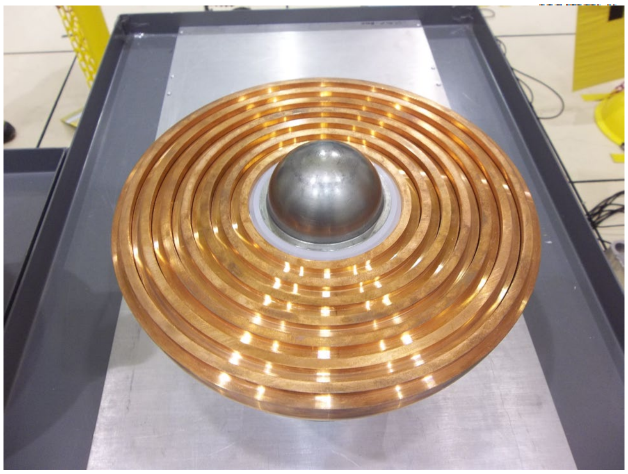
The Beryllium Reflected Plutonium (BeRP) ball is a 7.5 cm diameter, 4.5 kg alpha-phase plutonium sphere cast and clad in 1980 at Los Alamos National Laboratory. It has been used in many critical and subcritical experiments.



Initial Composition of the α-Phase Plutonium Sphere

Isotopes	Weight Percent Analysis 1	Weight Percent Analysis 2
^{238}Pu	0.020	0.020
^{239}Pu	93.73	93.74
^{240}Pu	5.96	5.94
^{241}Pu	0.268	0.269
^{242}Pu	0.028	0.028
^{241}Am	557 ppm	





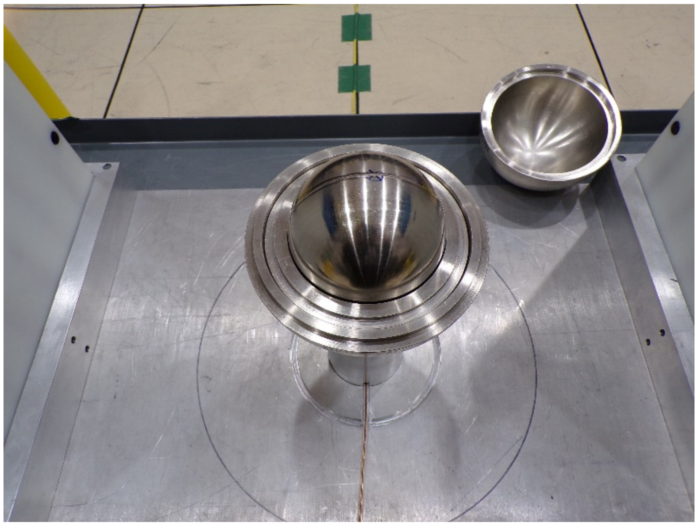
NCERC Inventory Highlights

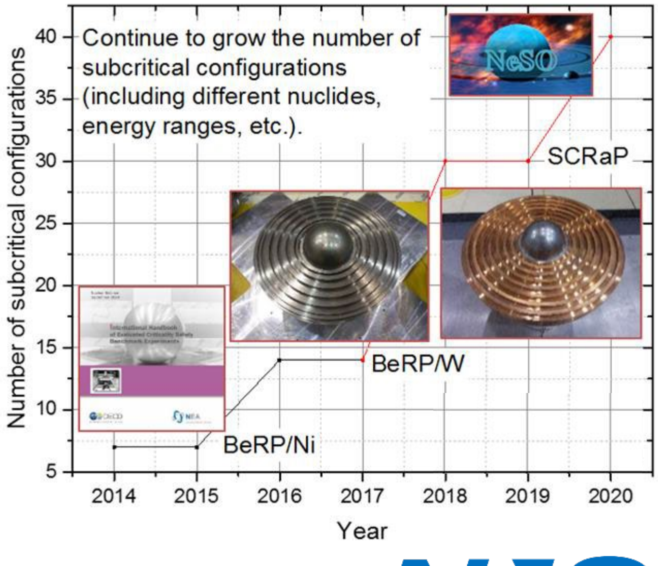
Np Sphere

The Np-sphere is a 9.6 cm diameter, 6 kg Neptunium sphere cast and clad in 2001 at Los Alamos National Laboratory to determine the critical mass of ^{237}Np. Tungsten and nickel cladding reduces the dose rate significantly. Experiments with the Np-sphere provide unique datasets to expand the growing database of subcritical benchmark configurations.

Table I. Composition and Spontaneous Fission Yield of the Np Sphere from July 2001.

Nuclide	Number Density (atoms/barn-cm)	Mass (g)	S.F. yield (neutrons/s)
^{237}Np	5.0926×10^{-2}	6.06×10^{3}	6.90×10^{-1}
^{233}U	1.8577×10^{-6}	2.17×10^{-1}	1.87×10^{-4}
^{234}U	2.9633×10^{-7}	3.48×10^{-2}	1.75×10^{-4}
^{235}U	1.4074×10^{-5}	1.66	4.96×10^{-4}
^{236}U	7.8349×10^{-8}	9.28×10^{-3}	5.09×10^{-5}
^{238}U	1.5626×10^{-6}	1.87×10^{-1}	$2.54 \times 10\text{-}^{3}$
^{238}Pu	8.2340×10^{-7}	9.83×10^{-2}	2.55×10^{2}
^{239}Pu	1.6271×10^{-5}	1.95	4.25×10^{-2}
^{240}Pu	1.1619×10^{-6}	1.40×10^{-1}	1.43×10^{2}
^{241}Pu	3.1166×10^{-8}	3.77×10^{-3}	1.88×10^{-4}
^{242}Pu	1.6032×10^{-7}	1.95×10^{-2}	3.35×10^{1}
^{241}Am	3.3375×10^{-7}	4.04×10^{-4}	4.76×10^{-4}
^{243}Am	9.1575×10^{-5}	1.12×10^{1}	-
Total		6.07×10^{3}	4.32×10^{2}





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